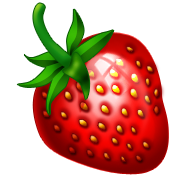
**By: Dr. Tatyana Simmers **

**For: Heather Fogell**

**Re: Essay#3 Design Lab Experiment**

**Date: 11/20/2010**

**Berry Full of DNA**

**Pennsylvania Standards Covered**

* 3.2.7. B Apply process knowledge to make and interpret observations.
* 3.3.7. C Know that every organism has a set of genetic instructions that determines its inherited traits.
* 3.7.7. B Use appropriate instruments and apparatus to study materials.

**Overview**

This DNA extraction results in a large quantity of white spoolable DNA. It is an easy investigation and there is almost no way for students to make a mistake that would affect the results. It is much more effective than extracting DNA from any other source.

**Background**

The native British wild strawberry is a "diploid" - it has two sets of chromosomes, as in humans. The most commonly cultivated strawberry, Fragaria ananassa, is an octoploid with eight sets. This makes it a good candidate for demonstrating DNA extraction - with eight copies of each gene in the strawberry genome, strawberries are packed full of it. The strawberry, it turns out, has a long and complicated family history. "The cultivated strawberry is interesting from a genomic perspective, because it's a polyploid hybrid species." Unlike peas, for example, or humans, for that matter, which are diploids (with two sets of chromosomes); a strawberry is an octoploid (with eight sets of chromosomes). How some strawberries evolved from diploids to octoploids is part of the story that people are trying to unravel. http://www.unhmagazine.unh.edu/sp04/research.html

Many people are surprised to find out that strawberry growers plant bare-root plants rather than seeds. The reason is every strawberry seed contains different genetic material, the product of a myriad of potential gene combinations. Because the genetics of strawberries are so diverse (humans are diploid, strawberries are octoploid), each of our varieties came from a single seed, which was cloned from a single mother plant. The mother plant puts out runners (called daughter plants) that were essentially identical to her, which in turn also put out runners. http://iml.jou.ufl.edu/projects/Fall2000/IAllen/Research%20and%20Development.htm

One of the reasons strawberries work so well is that they are soft and easy to pulverize. Also, ripe strawberries produce enzymes (pectinases and cellulases) which aid in breaking down the cell walls. Most interestingly, strawberries have enormous genomes. They are octoploid, which means they have eight of each type of chromosome (which equals abundant DNA).

The detergent in the shampoo helps to dissolve the phospholipid bilayers of the cell membrane and organelles. The salt helps keep the proteins in the extract layer so they aren’t precipitated with the DNA.

DNA is not soluble in ethanol. When molecules are soluble, they are dispersed in the solution and are therefore not visible. When molecules are insoluble, they clump together and become visible. The colder the ethanol, the less soluble the DNA will be in it yielding more visible “clumping.” This is why it is important for the ethanol to be kept in a freezer or ice bath.

**Expected Results**

When the students pour the ethanol on the strawberry extract, they will immediately see fine white strands of DNA form at the interface. When they stir the DNA into the ethanol layer, the DNA will form cotton candy-like fibers that will spool onto the stirring rod.

**Materials (per student group)**

* Heavy-duty Ziplok bag
* 1 strawberry (fresh or frozen)
* 10 ml DNA extraction buffer (soapy, salty water – recipe follows)
* Filtering apparatus: cheesecloth, funnel, and small beaker
* Ice cold ethanol
* Clear test tube
* Glass stirring rod or plastic coffee stirrer
* Microscope (optional)
* 2 tooth picks (optional)

**Lab Notes**

► The Ziploc bags should be as thick as possible. Bags designed for freezer storage are thicker and resist breaking much better than the sandwich type.

► Strawberries can be fresh or frozen. Fresh berries should be rinsed and the green sepals removed. If using frozen berries, thaw them out before the lab, but NOT quickly. (Quick heating will destroy the DNA double helix.) Other soft fruits like kiwis or bananas work, but do not yield nearly as much DNA.

► DNA extraction buffer recipe:

* 100 ml of shampoo (without conditioner) or 50 ml of dishwashing liquid
* 15 grams NaCl
* 900 ml water

► the ethanol must be at least 90% and it needs to be cold. Putting it in several small squirt or dropper bottles and keeping them on ice in the front of the room makes it easy to dispense.

► Cut squares of cheesecloth (two layers thick) large enough to hang over the edge of the funnel.

► This activity can be completed in one 40-minute class period.

**Answers to student questions**

1. What did the DNA look like?

*It looked like a mass of wet spider webs, mucus, or egg whites. ( “snot.”)*

1. A person cannot see single cotton thread 100 feet away, but if you wound thousands of threads together into a rope, it would be visible. How does this statement relate to our DNA extraction?

*DNA is far too narrow to see, but if there are many thousands of strands together, it is thick enough to be visible.*

1. In order to study our genes, scientists must extract the DNA from human tissue. Would you expect the method of DNA extraction we used for the strawberry to be the same for human DNA? Why or why not?

*It’s actually easier for animal cells. Animal cells do not have cell walls; therefore it wouldn’t be necessary to filter out the cellulose debris. Also, animal cells can be lysed if they’re put into a hypotonic solution.*

1. Is DNA the same in any cell in the human body? Explain your answer.

*Yes. Since we were once one cell and grew to an organism by mitosis, the entire DNA in our cells is identical.*

1. If you wanted to extract DNA from a living person, which cells would you use and why?

*Blood is the easiest tissue to obtain from living humans. White blood cells are used because they are nucleated, unlike red blood cells. Skin cells can be used if only a small amount of DNA is needed.*

1. Please list two reasons why a scientist might want to study the DNA of strawberries.
   1. *They might want to compare the DNA of a type of strawberry that is more disease or frost resistant than other strawberries.*
   2. *They might want to study a gene that could be useful in the medical field. For example, strawberries have a chemical in them that slows the growth of some tumors.*
   3. *They might want to clone a particular gene. Perhaps they would want to make large quantities of the protein that makes strawberries red or produces the desired flavor of strawberries.*

Laboratory design for DNA extraction from strawberry:

Cheesecloth

Filtration apparatus